Docket No. 263391US0PCT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: Haruo KAWAKAMI, et al.

SERIAL NO: 10/518,537 GAU:

FILED: December 30, 2004 EXAMINER:

FOR: SWITCHING ELEMENT

INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR 1.97

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

SIR:

Applicant(s) wish to disclose the following information.

REFERENCES

■ The applicant(s) wish to make of record the references listed on the attached form PTO-1449. Copies of the listed references are attached, where required, as are either statements of relevancy or any readily available English translations of pertinent portions of any non-English language references.

☐ A check or credit card payment form is attached in the amount required under 37 CFR §1.17(p).

RELATED CASES

☐ Attached is a list of applicant's pending application(s), published application(s) or issued patent(s) which may be related to the present application. In accordance with the waiver of 37 CFR 1.98 dated September 21, 2004, copies of the cited pending applications are not provided. Cited published and/or issued patents, if any, are listed on the attached PTO form 1449.

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CERTIFICATION

☐ Each item of information contained in this information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this statement.

☐ No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application or, to the knowledge of the undersigned, having made reasonable inquiry, was known to any individual designated in 37 CFR §1.56(c) more than three months prior to the filing of this statement.

DEPOSIT ACCOUNT

■ Please charge any additional fees for the papers being filed herewith and for which no check or credit card payment is enclosed herewith, or credit any overpayment to deposit account number 15-0030. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

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Form PTO 1449 (Modified) — U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

LIST OF REFERENCES CITED BY APPLICANT

ATTY DOCKET NO.	SERIAL NO.
263391US0PCT	10/518,537
APPLICANT: Haruo KAWAKAMI, et al.	
FILING DATE: December 30, 2004	GROUP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUB CLASS	FILING DATE IF APPROPRIATE
	AA						
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						
	AL						
	AM						
	AN						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	TRANSLATION YES	TRANSLATION NO
	AO	02/37500	05/10/02	WO		NO
	AP					
	AQ					
	AR					

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, etc.)

	AS	KAWAKAMI, Haruo et al. "Formation of Organic Switching Devices with Spin Coated Method", The abstract of 50th confederation lecture of Japan Society of Applied Physics, vol. 3, page 1340 2003
	AT	MA, L.P. et al. "Organic electrical bistable devices and rewritable memory cells", Applied Physics Letters, vol. 80, no. 16, pages 2997-2999 2002
	AU	MA, L.P. et al. "Data storage with 0.7 nm recording marks on a crystalline organic thin film by a scanning tunneling microscope", Applied Physics Letters, vol. 73, no.6, pages 850-852 1998
	AV	POTEMBER, R.S. et al. "Electrical switching and memory phenomena in Cu-TCNQ thin. films", Appl. Phys. Lett., vol. 34, no. 6, pages 405-407 1979
	AW	KUMAI et al. Solid –State Physics, vol. 35, pages 33-40, with partial English translation 2000
	AX	ADACHI et al. "Formation of Cu-TCNQ CT-Complex thin films by vacuum co-deposition and the switching devices", The abstract of meeting of Japan Society of Applied Physics, vol. 3, page 1236 2002
	AY	MA, Liping et al. "Organic bistable light-emitting devices", Applied Physics Letters, vol. 80, no. 3, pages 362-364 2002

☐ Additional References sheet(s) attached

Examiner	Date Considered

*Examiner: Initial if reference is considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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STATEMENT OF RELEVANCY

1) References AO, AS-AU have been cited in the International Search Report. Copies of these references are being submitted herewith only when not automatically provided by the International Searching Authority.

2) References_____ have been cited in the corresponding_____ Search Report. A copy of these references is being submitted herewith.

3) References AV-AX are discussed in the specification. A copy of these references is being submitted here with.

4) Reference AY is additional prior art known to Applicant. A copy of this reference is being submitted herewith.

(Kawakami et al, The abstract of 50th confederation lecture of Japan Society of Applied Physics, spring of 2003, the third volume, p1340).

[Title] 29p-B-8

Formation of Organic Switching Devices with Spin Coated Method

[Summary]

It has been reported by Y. Yang et al. that a device in which an organic material of aminoimidazole dicarbonitrile (AIDCN) is divided into two layers by an inter-middle layer of Al to have three-layered structure has electrical bistability. In this meeting, we report that a device of AIDCN, being single layered structure without any inter-middle layer, is as well capable of exhibiting electrical bistability.

[Experiment]

Onto a glass substrate, a vapor deposition was performed to form thin films of Al electrode layer, an AIDCN layer and Al electrode layer, in the order. The surface area of electrode in the device was 0.25 (mm^2), and the layers were 100/80/100 (nm) thick, respectively.

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STATEMENT OF RELEVANCY

KAWAKAMI et al., cont.

[Result]

Fig.1 shows an exemplary current-voltage characteristic of the present device. With bias voltage applied increasingly from 0 V, the insulting state (off state) at the beginning was shifted to a state (off/on transition state), where a sudden increase of current at a certain threshold voltage is observed. Then, the current was kept under the low resistance state (on state) even with bias voltage applied decreasingly. The threshold voltage was around 3V, and the ratio of on-state current to off-state current was 10^5. With the use of AFM, we observed a fine polycrystalline structure in the AIDCN layer. Further, we observed a peak signal of d=3.26Å in X-ray diffraction with configuration of out-of-plane, while not with configuration of in-plane or powdery, suggesting that the layer is formed with directional association onto the glass substrate.

(Adachi et al, The abstract of meeting of Japan Society of Applied Physics, spring of 2002, the third volume, p1236).

[Title] 27a-M-5

Formation of Cu:TCNQ CT-Complex thin films by vacuum co-deposition and the switching devices

[Summary]

Electrical switching phenomena in Cu:TCNQ (Tetracyanoquinodimethane) of a Cu/Cu:TCNQ/Al device has been reported by R. S. Potember et al.. However, the Cu/Cu:TCNQ/Al device prepared by a spontaneous electrolysis technique has a problem of making a thin film thereof, with unvarying quality, due to its property of large-size polycrystalline. It also has a problem in its durability on performing a switching characteristic. In this study, we have succeeded in applying vacuum co-deposition technique instead of the spontaneous electrolysis technique, controlling the ratio of the materials in co-deposition, to form amorphous-type thin film of Cu:TCNQ, which has properties of switching. The present device enables an organic LED composed thereof to drive, in which simple matrix circuit formed in the element of the device can function as an active circuit.

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STATEMENT OF RELEVANCY

ADACHI et al., cont.

[Experiment]
After deposition of 20nm-thick Al onto a cleaned ITO substrate, the formed Al film was exposed to air and subjected to an UV treatment, which made the surface oxidized into Al_2O_3. Then a co-deposition to form 100nm-thick Cu:TCNQ was performed onto the Al film, which was followed by deposition of Al to be 100nm thick, thereby forming the present device. We have investigated the effect of the ratios of materials i.e. 0:1, 1:2, 1:1, 3:2, 2:1, 4:1 on co-deposition of Cu:TCNQ. The device formed was subjected to a low current treatment for aging to induce the switching characteristic.
[Result]
When Cu is contained in Cu:TCNQ with the ratio of 1:1 or more, amorphous-type thin film of Cu:TCNQ can be formed evenly. On the other hand, with less content of Cu in Cu:TCNQ, a film with ~2μm-size particle of polycrystalline was formed and the film was not formed evenly. The thin film of Cu:TCNQ with the ratio of 1:1 exhibited, because of its CT complex, new absorption between the region of visible radiation of 600nm~1200nm. In IR spectrum, it was also observed that the film exhibited new absorption because of its CT complex, in which the peak frequency 2226 cm^{-1} caused by oscillation of CN residue in a single layered film of TCNQ was shifted to high frequency domain, resulting with the peaks of 2197 and 2168 cm^{-1}. The device of ITO/Al/Cu:TCNQ/Al exhibited a reliable switching characteristic on applying a voltage of 10 ± 2 V (Fig. 1). With bias voltage applied in the order as indicated in the figure with the corresponding numbers, the high resistance state went on during the course from negative bias to positive bias, and then the state was shifted to the low resistance state at around 10 V during the course conversely from positive bias to negative bias. Further, with bias voltage applied in the low resistance state to increase toward positive bias, the state was again shifted to the high resistance state at around -10 V. This cycle can be attained repeatedly ~100 times, in which, between low resistance state and high resistance state, the ratio of current density at a bias voltage of 5 V was up around one magnitude.